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Original Article

AN EVALUATION OF YIELD POTENTIAL OF RICE (*Oryza Sativa*) GENOTYPES UNDER CONSERVATION AGRICULTURAL PRACTICES IN EASTERN HILL PLATEAU REGION OF INDIA

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ABSTRACT

The study was carried out to evaluate three rice genotypes of paddy viz., Lalat, IR-64 & Naveen under conservation agricultural practices as farmer puddle transplanted (FP-T), zero tillage transplanted (ZTT) and zero tillage with direct seeded rice (ZT-DSR) at farmers field during kharif season of 2016 and 2017. The two years pooled data revealed that higher number of tillers/plant (8.72) and numbers of panicle/row (49.6) were recorded in FP-T while panicle length had no significant effect. The highest number of grains per panicle was observed in farmer's practice 134.6 and followed by direct seeded rice (123.6) and least in zero tillage transplanted rice (120.0). Similarly significantly highest numbers of filled grains per panicle (113.3) was recorded in FP-T and least in zero tillage transplanted rice (96.60). However the grain filling percentage was found maximum in direct deeded rice (89.3 %) followed by farmer's practice (84.80 %) and least in zero tillage transplanted rice (78.8%). The grain yield in both the years found highly significant. The farmers practice recorded the highest yield of 5.35 t ha^{-1} followed by zero tillage transplanted rice (4.23 t ha^{-1}) and least in direct seeded rice (4.16 t ha^{-1}). However, the harvesting index was found highest in zero tillage transplanted rice (0.52) and least in direct seeded rice (0.48). Among the genotypes, the highest number of tillers per plant was recorded in Lalat (7.78) followed by IR-64 (7.76). The highest number of panicle per meter row (48.7) was recorded in IR-64 and least in Naveen (46.93). The maximum panicle length (23.84 cm), number of grains per panicle (142.95) and number of filled grains per panicle (130.7) was found in Naveen. The farmers practice revealed higher gross return of Rs. 81,855 ha^{-1} with a benefit- cost ratio of 2.72 and net return of Rs.51, 785 ha^{-1} as compared to the direct seeded rice which gave the net return (Rs.38, 128 ha^{-1}) and benefit-cost ratio (2.49) and least was recorded in zero tillage transplanted rice of net return of Rs 36,899 ha^{-1} and BC ratio 1.13.

***KEYWORDS:** Direct Seeded Rice, Zero Tillage Transplanting, Conventional Tillage, Farmers Practice, Economics & Harvest Index*

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INTRODUCTION

Rice is the most important cereal crop of the developing world and the staple food of more than half of the world's population. India is having rice cultivation area of 44.6 million hectares with production of 132 MT and an average productivity of 2.96 t/ha (Pandian, 2009). One-fifth of the world's population depends on rice cultivation for their livelihoods. In Asia, about 90% of the area is rice grown and around 65% of the total populations in India consume rice and it accounts for 40% of their food production. India is the world's second largest producer of white rice, comprising of 20% of the world rice production. The world production of rice has risen steadily from

about 200 million tons of paddy rice in 1960 to over 678 million tons in 2009. Rice-based production systems provide the main source of income and employment for more than 50 million households. The rice production in India contributes a major part of the national economy. Rice is also the main staple food crop of Jharkhand. The Jharkhand state ranks twelfth and produces about three per cent rice of total rice production of India. The Ranchi, Paschim Singhbum, Purb Singhbum, Lohardaga and Gumla are the chief rice producing districts and majority of the rice grown as rain fed with an average productivity of 2.97 t/ha. The achieving self-sufficiency in rice production and maintaining price stability are important political objectives in low-income countries because of the importance of this crop in providing national food security and generating employment and income for low-income people (Ghosh *et al.,* 2009). Since a large portion about 70 % of the area under rice in India is drought prone rain fed (Kumar *et al.,* 2012). Therefore a suitable conservation agricultural technologies may play a vital role in the utilization of such area in eco friendly and sustainable production of rice globally.

Growing more rice with reduced cost of production and maintaining soil health are the major concerns of rice farming globally (Rao *et al*., 2016). The suitable genotype of rice and good crop establishment is one of the vital components for efficient use of resources and desired level of productivity in rice. Establishing rice by manual transplanting is labour intensive and excessively puddling of soil increasingly difficult due to higher cost of operation and shortage of man power (Verma and Singh, 2016). The traditional method requires more tillage practices and too many time of repetition of tillage implements before sowing of seed. This tillage practice is very time consuming, expensive and needed hard labour. But in the new concept of modern agriculture, the farming is tending towards the tillage practice should be minimum or no tillage practice required. Under these circumstances the zero tillage technology is economical, time saving and easy to operate and opportunity to utilize the soil moisture in succeeding Rabi crops after harvest of paddy. The new improved technologies of conservation agriculture will eventually lead to the farmers to discontinue the conventional tillage practices. The emphasis was to compare the productivity of the rice genotypes under conservation agriculture practices for rice production at farmer’s field by providing them required primary agricultural inputs such as seeds, fertilizers, insecticides/ pesticides etc. together with technical guidance and also financial helps. The farmers’ decision to adopt conservation agricultural practices of rice depends upon various factors. The studies on adoption of rice technologies indicate that the adoption behaviour of farmers is governed by a diversified set of factors such as their socio-psychological and economic factors, characteristics of innovations and quality of extension work (Bhagat, 1983; Mahant, 1989; Jha, 1991; Hugar *et al*., 1992). The practically feasible and readily adoptable eco friendly technology to enhance production and productivity of the rice would be the conservation agricultural technology in near future.

The change in method of rice establishment is inevitable to improve productivity, profits and sustainability by adopting conservation agriculture practices too. Direct seeding of seed, zero tillage transplanting of paddy are some of the methods of crop establishment under conservation agricultural practices which require less water and less reliant on labour as compared to the conventional practice of manual transplanting (Rao *et al*., 2015). Therefore present study was under taken to find out productive and remunerative rice genotypes under different establishment under conservation agricultural practices at farmers field of Ranchi, Jharkhand.

MATERIALS AND METHODS

The experiment was conducted in the farmer’s field at Chene, Ranchi (Jharkhand) located at Lat: 23°17'2.59"N, Long: 85°26'9.84"E during two consecutive *kharif* seasons of 2016 and 2017 under edaphic and climatic conditions of Eastern Plateau and Hill Region, Ranchi (Jharkhand.). The conservation agricultural methods as farmers puddle

transplanted Rice (FP-TR), zero tillage direct seeded rice (ZTDSR) and zero tillage transplanted rice (ZTTR) transplanted rice was undertaken. The layout of the trial was randomized block design with three replications. The area of each plot was 20 m^2. Seedlings were transplanted with an average of one seedling/hill in the farmers puddle transplanted rice and zero tillage transplanted rice. Application of 10 t FYM/ha was given uniformly to all the plots before final puddling and leveling in the farmers puddle transplanted rice. Fertilizer with a uniform dose of 120: 60: 40 kg/ha N, P and K through urea, DAP and MOP was applied in all the plots in DSR as a band placement and top dressing in zero tillage transplanted rice .

The soil of the experimental site was slightly acidic in reaction (pH-5.5), sandy clay loam texture with medium organic carbon content (0.57 %), medium in nitrogen (282.0 kg ha-1), low in phosphorus (10.7 kg ha-1) and medium in potassium (176.0 kg ha-1) contents. The top 30 cm soil had a bulk density of 1.46 g/cc. The standard recommended cultural and plant protection measures followed for respective establishment methods as per the treatments. Organic manures were applied based on their nutrient content and incorporated three weeks before planting. The observations on different growth and yield parameters were taken and economic analysis was done by calculating the cost of cultivation, gross return, net return and B: C ratio. Final crop yield were recorded and the gross return were calculated on the basis of prevailing market price of the produce. The data were statistically analyzed applying the techniques of analysis of variance and the significance of different sources of variations were tested by error mean square of Fisher Snedecor's 'F' test at probability level 0.05 (Cochran and Cox, 1977).

RESULTS AND DISCUSSIONS

The analysis of pooled data results obtained for yield attributing characters of rice genotypes are depicted in Table 1 & 2. Significantly higher number of tillers/plant (8.72) and higher numbers of panicle/row (49.6) were recorded in FP-T while panicle length had no significant effect. The highest number of grains per panicle was observed in farmer's practice 134.6 and followed by direct seeded rice (123.6 and least in zero tillage transplanted rice (120.0). Similarly significantly highest numbers of filled grains per panicle (113.3) was recorded in FP-T and least in zero tillage transplanted rice (96.60). However the grain filling percentage was found maximum in direct deeded rice (89.3 %) followed by farmer's practice (84.80 %) and least in zero tillage transplanted rice (78.8%). The grain yield in both the years found highly significant.

Table 1: Effect of Different CA Practice on the Yield Attributing Characters of Rice

Treatment	No. of Tillers/Plant		Pooled Mean	No.of Panicle/m row		Pooled Mean	Panicle length (cm)		Pooled Mean	No.of Grains/Panicle		Pooled Mean
	2016	2017		2016	2017		2016	2017		2016	2017	
C1: Farmer practice	7.44	10.0	8.72	61.44	49.6	55.52	25.11	23.0	24.06	138.7	130.50	134.6
C2: ZTDSR	4.56	10.1	7.33	46.00	48.5	47.25	23.87	23.5	23.69	122.9	124.3	123.6
C3: ZTT	5.36	9.0	7.18	43.67	46.8	45.24	22.62	22.8	22.71	122.7	117.3	120.0
SEm (±)	0.40	0.1		1.55	0.2		---	0.2		3.55	0.3	
C.D. at 5%	1.20	NS		4.65	1.6		NS	NS		10.64	1.9	

The farmers practice recorded highest yield of 5.35 t ha^{-1} and followed by zero tillage transplanted rice (4.23 t ha^{-1}) and least was recorded in direct seeded rice (4.16 t ha^{-1}). Murthy *et al.* (2015) reported similar findings of superior performance of alternate systems of rice establishment on crop and water productivity of in rice. However, the harvesting index was found highest in zero tillage transplanted rice (0.52) and least in direct seeded rice (0.48). Rao *et al.,* (2015) also reported the similar findings among different establishment methods direct sowing by drum seeder

resulted lesser grain yield, however, it was at par to dry direct sowing and transplanting.

Table 2: Effect of Different CA Practice on the Yield Attributing Characters of Rice

Treatment	No. of filled grains/panicle		Pooled Mean	Grain filling (%)		Pooled Mean	Grain yield (t/ha)		Pooled Mean	Harvest Index		Pooled Mean
	2016	2017		2016	2017		2016	2017		2016	2017	
C1: Farmer practice	114.3	112.3	113.3	82.7	86.9	84.80	5.81	4.89	5.35	0.48	0.53	0.51
C2: ZTDSR	100.7	109.6	105.15	81.7	89.3	85.50	4.31	4.01	4.16	0.44	0.52	0.48
C3: ZTT	101.4	91.8	96.60	83.1	78.8	80.95	4.02	4.43	4.23	0.49	0.54	0.52
SEm (±)	3.40	0.3		---	0.2		1.17	0.19		0.008	0.0	
C.D. at 5%	10.21	1.8		NS	1.4		3.51	6.5		0.026	NS	

The analysis of pooled data results obtained for yield attributing characters of rice genotypes are depicted in Tables 3 & 4. Among the genotypes, the highest number of tillers per plant was recorded in Lalat (7.78) followed by IR-64 (7.76). The highest number of panicle per meter row (48.7) was recorded in IR-64 and least in Naveen (46.93). The maximum panicle length (23.84 cm), number of grains per panicle (142.95) and number of filled grains per panicle (130.7) was found in Naveen.

Table 3: Effect of Different CA Practice on the Yield Attributing Characters of Rice Genotypes

Treatment	No. of Tillers/Plant		Pooled Mean	No. of Panicle/m Row		Pooled Mean	Panicle Length (cm)		Pooled Mean	No. of Grains/Panicle		Pooled Mean
Genotypes	2016	2017		2016	2017		2016	2017		2016	2017	
V1: Naveen	5.18	9.4	7.29	48.56	45.3	46.93	24.07	23.6	23.84	143.2	142.7	142.95
V2: Lalat	5.96	9.6	7.78	50.22	44.2	47.21	23.78	22.8	23.29	126.7	126.6	126.65
V3: IR 64	6.22	9.3	7.76	52.33	48.7	50.52	23.76	23.6	23.68	114.3	114.3	114.30
SEm (±)	---	0.2		---	0.2		---	0.2		3.55		
C.D. at 5%	NS	NS		NS	0.7		NS	NS		10.64		

However, the highest number grains filling percentage (86.2%) was recorded in IR-64 followed by Lalat (83.30 %). The genotype Lalat recorded consecutively maximum grain yield of 4.78 t ha^{-1} followed by Naveen (4.67 t ha^{-1}) and least in IR-64 (4.28 t ha^{-1}). The highest harvest index (0.51) was recorded in IR-64 and genotype Naveen and Lalat recorded the same value of harvest index.

Table 4: Effect of different CA practice on the Yield Attributing Characters of Rice Genotypes

Treatments	No. of Filled Grains/Panicle		Pooled Mean	Grain Filling (%)		Pooled Mean	Grain Yield (t/ha)		Pooled Mean	Harvest Index		Pooled Mean
Genotypes	2016	2017		2016	2017		2016	2017		2016	2017	
V1: Naveen	143.2	118.2	130.70	78.7	82.9	80.80	4.91	4.43	4.67	0.47	0.53	0.50
V2: Lalat	126.7	106.2	116.45	81.2	85.4	83.30	4.96	4.59	4.78	0.46	0.54	0.50
V3: IR 64	114.3	97.6	105.95	87.5	86.2	86.85	4.26	4.30	4.28	0.48	0.54	0.51
SEm (±)	3.55	4.27		0.70	0.3		1.17	0.22		---	--	
C.D. at 5%	10.64	12.66		2.11	0.7		3.51	NS		NS	NS	

NS= Non-significant

The Lalat and Naveen genotypes recorded significantly higher grain yield over IR-64 irrespective of conservation agriculture practices. An economic analysis of the pooled data revealed that farmers practice produced higher grain yield of 5.35 t ha^{-1} which is 28.60 % higher yield than direct seeded rice. This may be attributed to high tillers, high vegetative biomass production and high numbers of filled grains per panicle. The result obtained is in conformity with Samant *et al.*, (2015). The Lalat recorded the higher grain yield (4.78 t ha^{-1}) in comparison to Naveen (4.67 t ha^{-1}). These results are in conformity with Tripathi *et al.*, (2013).

ECONOMICS

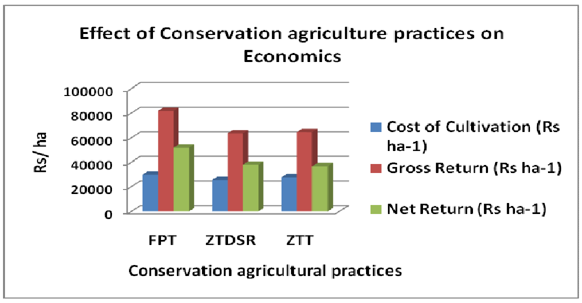

Figure 1

An analysis on economics (Figure 1) revealed that the farmers practice revealed higher gross return of Rs. 81,855 ha-1 with a benefit- cost ratio of 2.72 and net return of Rs.51, 785 ha^{-1} as compared to the direct seeded rice which gave the net return (Rs.38, 128 ha^{-1}) and benefit-cost ratio (2.49) and least was recorded in zero tillage transplanted rice of net return of Rs 36,899 ha^{-1} and BC ratio 1.13. Mitra *et al*, 2014 also reported the advantages of growing newly introduced variety over the traditional with higher return, the variation in net return and benefit-cost ratio may be attributed to the variation in the price of agri inputs and produce. These finding are also similar with the findings of Nirmala *et al.* (2012).

CONCLUSIONS

It can be concluded that farmers' traditional practices is yielding better than conservation agriculture practices however it would be better to adopt conservation agricultural practices which gave comparable yield and economic returns. The growing of Lalat variety under conservation agriculture practices produced the highest grain yield and net monetary returns and benefit cost. Among conservation agriculture practices, direct seeded rice proved as productive and emerged more remunerative than zero tillage transplanting system.

CONSTRAINTS

The farmers have the pre occupied mindset that tillage has direct relation to crop production and the seeding or sowing is not possible without tillage practice. They opined that tillage operation in seeding/transplanting as more number of plowing is cause of high yield in crops and less number of plowing low yield. However, in modern technology the researcher's emphasizing that the minimum disturbance of soil in case of seeding. According to minimum soil disturbance concept, the zero tillage technology introduced between farmers. The recent past few years, due to globalization, it is necessary to put low cost of agricultural produce. Due to increase of input cost of produce and low selling price, the zero tillage technology is adaptable. The zero tillage technology is very valuable and may be very wildly accepted and easy technology in near future. The use of zero tillage save, the fuel, time of sowing, seeds, water, fertilizer and man power.

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